

California Hydrogen Highway Network

Hydrogen Infrastructure May 2010

California Air Resources Board



Hydrogen Infrastructure ZEV/Customer Driven

- ZEV Regulation
- Blueprint Plan
- Vehicle requirements
- Cluster development & Demographics
- Vehicle rollout/survey results



ARB/CEC Hydrogen FCV Statewide Survey Results

	Thru 2012	Thru 2014	2015 – 2017
Passenger Vehicles	400+	1,800+	40-50,000
Fuel cell Buses	15+	20-60	60-150



2005 California Hydrogen Blueprint Plan

Findings and Recommendations

- Develop station Networks in phases
 - 50 stations by 2010
 - Begin networks in major metropolitan areas
- Funding
 - \$6.5m annually for 5 years (stations)
 - \$4.2m annually for 5 years (vehicle incentives)
- Environmental Goals
 - 30% reduction in GHG relative to conv vehicles
 - Utilize 33% renewable resources in production of H₂
 - No increase in toxics and smog forming pollutants
- Implementation
 - State establish policies to create H₂ infrastructure
 - Cal/EPA lead outreach for CaH₂ Network



California Hydrogen Infrastructure Funding History

- June 2008 = \$8.1 million
 - OCSD Air Products, AC Transit, CSULA
- March 2009 = \$6.8 million
 - Mebtahi Chevron, SFO, Shell Hydrogen, UCLA
- May 2010 = \$4.4 million (CEC/ARB)
 - O&M for City of Burbank, Oakland Transit Station
- September 2010 = \$19 million (AB-118)
- Spring 2011 = \$14 million (AB-118)



Hydrogen Station Equipment Costs – Different Configurations

Technology	Kg/day	EQ cost
Gaseous Delivery	100 - 200	\$200 - 500k
Liquid delivery	100 – 200+	\$1.2 – 1.5M
Pipeline	100 - 200+	\$800k
Onsite Electrolyser	100	\$1.2M
Onsite SMR	100+	\$2 – 3M



Northern California Region

Greater SF Bay Area Cluster

- **SF Peninsula – San Francisco International Airport**
 - LD/Shuttle bus station
 - Delivered Liquid Hydrogen & Hythane
 - Status – working on Linde/SFO lease agreements
 - Expected opening 2Q 2011
- **East Bay Area – AC Transit District Oakland & Emeryville stations**
 - Integrated LDFCV/HD FCB station
 - LDV 100% renewable powered electrolyzer
 - Status undergoing permitting process
 - Construction 3rd Q 2010
 - Expected Opening 4Q 2010



Southern California Region Greater Los Angeles Area

- **Santa Monica/West LA Cluster**
 - Shell Santa Monica
 - Electrolyser, 350bar, canopy
 - University of California Los Angeles
 - Steam Methane Reformer, LDFCV station,
- **East Los Angeles/South Pasadena**
 - California State University Los Angeles
 - 100% renewable Electrolysis, LDV station,
- **San Fernando Valley**
 - City of Burbank – City yard
 - Steam Methane Reformer/Tube trailer, LDFCV/Transit station



Southern California Region

Greater Los Angeles Area

- **South Torrance Cluster**
 - Torrance Shell
 - pipeline
 - Harbor City – Chevron Station
 - High Pressure Delivered gaseous, awaiting final permitting
- **Newport Beach Cluster**
 - Shell – Fashion Island full retail
 - , SMR, await final permitting
- **Irvine Cluster**
 - UCI
 - delivered liquid
- **Fountain Valley/I405 connector**
 - Orange County Sanitation District/A.P.
 - Waste water DG cleanup/high temp Fuel Cell



Some Tasks that can Challenge a Projects Critical Path

- Original **Contracts/Grant/awards process** within federal, state and local government can add months to a project timeline
- **Lease/Indemnification/language Agreements** among all major partners can add months to a projects timeline
- Long **equipment lead times** on non “off-the-shelf” items including storage tubes, electrolyzers reformers, etc. can add tens of months to a timeline
- California relies on **local permitting** jurisdictions who may not have experience in the handling of high pressure hydrogen adds weeks and possibly months to a 3 month timeline
- **Codes and Standards** for some stationary applications lacking may
- **Fueling protocols**
 - All OEM vehicle fueling communication/tank systems are not yet identical
 - All fueling station equipment protocols/chillers etc are not identical
 - Therefore stations/OEMs need to be “qualified” on a station-by-station basis
- At this point in the FCV rollout, the relatively **low vehicle numbers** do not present a compelling business case of the station owner/operator



Challenges to Infrastructure

- ***Contracts/Grant/awards process*** within federal, state and local government can add months to a project timeline
- ***Lease/Indemnification/language Agreements*** among all major partners can add months to a projects timeline
- ***Equipment lead times*** on non “off-the-shelf” items including storage tubes, electrolyzers reformers, etc. can add tens of months to a timeline
- ***Local permitting authorities*** – often have experience in permitting f high pressure hydrogen - can add weeks and possibly months to a 3 month timeline
- ***Codes and Standards*** – some are still in development
- ***Fueling protocols***
 - Vehicle fueling communication/tank systems are not identical
 - Fueling station equipment protocols/chillers etc are not identical
- ***No clear Business case*** – pre commercialization vehicle numbers ***low fuel throughput***



Fuel Cell Vehicle Deployment Major Metropolitan Areas

Area	2011	2012	2013
Los Angeles	232	345	489
San Diego	8	8	23
Bay Area	34	48	91
Sacramento	25	38	60

